

RESEARCH PROPOSAL TO CEBAF

Search for Narrow Excited States of the Proton

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Abstract

We propose a measurement of the reaction $e + p \rightarrow e' + X$ to search for narrow excited states of the proton, p^* , in the mass region:

$$M_p < M_x < M_p + 1250 \text{ MeV}$$

The sensitivity of the proposed measurements is more than a factor of 50 better than in previous experiments. We will use the Hall C HMS spectrometer to measure the scattered electron, e' , at a 12.5° angle. Beam energies of .3 GeV and 4 GeV and a maximum beam current of $60 \mu\text{A}$ are proposed, for a total of 50 hours. The experiment will use a 10 cm long liquid hydrogen target. The use of this thin walled target, together with the expected spectrometer resolutions and beam resolutions will provide excellent missing mass resolution. With very high sensitivity, at the lower beam energy, .3 GeV, the mass region $M_p < M_x < M_p + 140 \text{ MeV}$ will be covered. At the higher beam energy, 4. GeV, the mass region $M_p < M_x < M_p + 1250 \text{ MeV}$ will be scanned with very good sensitivity.

An indication of the proposed experiment's sensitivity is that any narrow state, p^* , will be detected if its cross section relative to elastic scattering is greater than 2×10^{-5} in the region $M_p < M_x < M_p + 140 \text{ MeV}$. There is a suggestion, by R. P. Feynman, concerning the possible existence of a colored proton, p_c , at a mass of about 990 MeV. In terms of coupling constants, this p_c is expected to be detected if the color carrying part of the photon has a strength α_c , relative to the electromagnetic coupling constant α_{EM} , of $\alpha_c / \alpha_{EM} \geq 2 \times 10^{-5}$.

Requests: The Hall C HMS spectrometer operated for high resolution for electron measurements. Beams of a maximum current of 60 μA at .3 GeV and 4 GeV, each for 24 hours. 10 cm liquid hydrogen target. (This experiment might be run simultaneously with the proposed experiment: Search for Direct Conversion of Electrons into Muons)

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